Moles and Rxns Stoichiometry AE

$4\,Fe + 3O_2 \longrightarrow 2Fe_2O_3$

Coefficients tell us # of moles

4 mol Fe 3 mol O_2 2 mol Fe_2O_3

Whole Basis behind this idea is a Ratio.

Compare Iron to O_2 4 mol Fe : 3 mol O_2

Can make this as a fraction $\frac{4\text{ mol Fe}}{3\text{ mol }O_2}$ or $\frac{3\text{ mol }O_2}{4\text{ mol Fe}}$

Iron oxide to Oxygen

$$\frac{2\text{ mol }Fe_2O_3}{3\text{ mol }O_2}$$

for $2Mg + O_2 \longrightarrow 2MgO$ $\frac{1\text{ mol }O_2}{2\text{ mol MgO}}$ $\frac{1\text{ mol Mg}}{1\text{ mol MgO}}$

do worksheet.
of Ratios

Now Stoichiometry (mass Relationships in Rxns)

First kind <u>mol-mol</u> Relies totally on molar Ratios

Convert from mol of one compound in a Rxn to another

$$4Fe + 3O_2 \longrightarrow 2Fe_2O_3$$

If 4mol of Fe used how many mol O_2 needed?

(use molar Ratio to convert) Convert from: Fe to O_2

$$4\,\text{mol Fe} \times \frac{3\,\text{mol } O_2}{4\,\text{mol Fe}} = 3\,\text{mol } O_2$$

↑ From Rxn. Use coefficients to make Ratio of moles

you know there is 3 mol of O_2 to 4mol of Fe so just make conversion so it flips

What if 2mol Fe How many mol of O_2

$$2\,\text{mol Fe} \times \frac{3\,\text{mol } O_2}{4\,\text{mol Fe}} = 1.5\,\text{mol } O_2$$

half as much O_2 b/c half as much Fe!

In Rxn $4P + 5O_2 \longrightarrow 2P_2O_5$

If 8 mol of P how many mol O_2? mol P_2O_5?

do sheet of Problems

Flow chart

In Rxn

$$A + B \longrightarrow C + D$$

If go mol A $\longrightarrow$ mol C

$$\text{mol A} \times \frac{\#\ \text{mol C}}{\#\ \text{mol A}} = \text{mol C}$$

Coefficient

:r mol to Mass

$$\text{mol A} \rightarrow \text{mol B} \longrightarrow \text{g B}$$

Step 1 $\times \frac{\text{mol B}}{\text{mol A}}$ Step 2 $\times \frac{\text{g B}}{\text{mol B}}$

Convert to mol B using coefficients

Convert to mass using molar mass

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

If 4.0mol of H_2 used how many g of N_2 needed?

Step 1. convert to mol of N_2

$$4.0\text{mol } H_2 \times \frac{1\text{mol } N_2}{3\text{mol } H_2} = 1.3\text{mol } N_2$$

Step 2 convert to mol NH_3

$$1.3\text{mol } N_2 \times \frac{28.0\text{g } N_2}{1\text{mol } N_2} = 37\text{g } N_2$$

If 2.1mol NH_3 produced how many g of N_2 used?

$$2.1\text{mol } NH_3 \times \frac{3\text{mol } H_2}{2\text{mol } NH_3} \times \frac{2.0\text{g } H_2}{\text{mol } H_2} = \boxed{6.3\text{g } H_2}$$

Compare processes

mol → mass mol A → mol B $\times \frac{g\,B}{mol\,B}$ → mass B

mass → mol mass A → mol A $\times \frac{mol\,B}{mol\,A}$ → mol B

$\times \frac{g\,A\ mol\,A}{mol\,A}$

Do Wksht

Mass - Mol / Mol - Mass Stoich

We don't measure in ~~grams~~ mols we use grams

So lets factor in grams into Stoich

Review g → mol

g → mol

$$\times \frac{1\,mol}{x\,g}$$

↑ Molar Mass

mol → g

$$\times \frac{x\,g}{1\,mol}$$

Try 16.0g of NaCl = ? mol NaCl

$$16.0\,g \times \frac{1\,mol\ NaCl}{58.5\,g\ NaCl} = 0.27\,mol\ NaCl$$

→

Now work into Stoich

Flow chart

mass – mol

$gA \longrightarrow mol\ A \longrightarrow mol\ B$

$\times \frac{1\ mol\ A}{H\ g\ A}$ ← Molar Mass

Step 1 Convert to mol A

$\times \frac{O\ mol\ B}{O\ mol\ A}$ ← Coefficient

Step 2 convert to mol B

Rxn $N_2 + 3H_2 \longrightarrow 2NH_3$

If 12.0g of H_2 are used Howmany mol NH_3 yelded?

Step 1 convert to mol H_2 $12.0\ g\ H_2 \times \frac{1\ mol\ H_2}{2\ g\ H_2} = 6\ mol\ H_2$

Step 2 Convert to Mol NH_3

$6\ mol\ H_2 \times \frac{2\ mol\ NH_3}{3\ mol\ H_2} = \boxed{4\ mol\ NH_3}$

If 6g of N_2 used, Howmany mol H_2 needed?

$6\ g\ N_2 \times \frac{1\ mol\ N_2}{28\ g\ N_2} = 0.214\ mol\ N_2 \times \frac{3\ mol\ H_2}{1\ mol\ N_2} = \boxed{0.642\ mol\ H_2}$

Now the culmination of over a week of work.

Mass to Mass Stoichiometry!

2 Flow charts

$$\text{mol A} \longrightarrow \text{mol B} \longrightarrow \text{mass B}$$

$$\text{mass A} \rightarrow \text{mol A} \longrightarrow \text{mol B}$$

$$\downarrow \qquad \downarrow \qquad \downarrow \qquad \downarrow$$

$$\text{mass A} \longrightarrow \text{mol A} \longrightarrow \text{mol B} \longrightarrow \text{mass B}$$

Step 1 Convert mass A $\times \frac{\text{mol A}}{\text{g A}}$ ↓ mol A

Step 2 Convert mol A → mol B $\times \frac{\text{mol B}}{\text{mol A}}$ (use coeff)

Step 3 Convert mol B → g B $\times \frac{\text{g B}}{\text{mol B}}$

$$Zn + 2HCl \longrightarrow H_2 + ZnCl_2$$

If 65 g of Zn are used How many g of H_2 are produced?

$$65\text{g Zn} \times \frac{1\text{mol Zn}}{65\text{g Zn}} = 1\text{mol Zn} \times \frac{1\text{mol } H_2}{1\text{mol Zn}} = 1\text{mol } H_2 \times \frac{2\text{g } H_2}{1\text{mol } H_2} = 2\text{g } H_2$$

Step 1 Step 2 Step 3

% Yield, Theoretical yield, Actual Yield

Theoretical yield → max amount of product ~~calculated~~ that can be ~~determined~~ obtained in a rxn (mathematically determined).

Actual yield → actual amount of product obtained in a rxn (experimentally observed)

Percent yield → $\frac{\text{actual}}{\text{theoretical}} \times 100\%$

Ex Rxn $C_6H_6 + Cl_2 \longrightarrow C_6H_5Cl + HCl$

36.8 g yields 38.8 g

Find % yield.

1st Theoretical $36.8\text{ g} \times \frac{1\text{ mol}}{78.1\text{ g}} \times \frac{1\text{ mol } C_6H_5Cl}{1\text{ mol } C_6H_6} \times \frac{113\text{ g } C_6H_5Cl}{\text{mol } C_6H_5Cl} = 53.2\text{ g } C_6H_5Cl$

$\% = \frac{38.8\text{ g}}{53.2\text{ g}} \times 100\% =$ ~~0.7292%~~ 72.9 %